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PRELIMINARY NOTES ON THE NATURAL CONTROL OF THE EUROPEAN SPRUCE SAWFLY BY SMALL MAMMALS

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INTRODUCTION

The importance of small mammals as natural control factors for forest insect pests has been indicated by several investigators, particularly by Hewitt (8) and Graham (5) with respect to the larch sawfly, *Pristiphora erichsoni* Htg. and by Sim (9) with respect to the Japanese beetle, *Popillia japonica* Newm. In general, however, the value of the small mammal fauna has not been appreciated by foresters and entomologists, as has been well shown by Hamilton and Cook (6). There is a considerable number of forest weevils and defoliators which spend part of their life cycle in the forest floor where they are susceptible to the continuous searching of these small but voracious predators.

The valuable control work effected by small forest mammals through their feeding on cocoons of the European spruce sawfly, *Gilpinia hercyniae* Htg., has been apparent throughout the course of investigations on the sawfly, and their importance has already been indicated by Balch (1). In 1941, investigations were started by the writer for the purpose of obtaining information about the feeding habits, populations, and environmental requirements of the small forest mammals of Eastern Canada in relation to the control of the sawfly. The field work carried out to date has been largely confined to central New Brunswick, although some work has been done in the Gaspé and in southern New Brunswick. Recently, it became necessary to interrupt this study temporarily and, therefore, it is thought desirable at this time to place on record a brief account of the results obtained to date.

DEGREE OF CONTROL

The best measure of the degree of control effected by small mammals lies in the numerous records of sawfly cocoon collections made by the staff of the Fredericton laboratory in many different localities in Eastern Canada during the past twelve years. These cocoon collections were analysed and the cocoons classified as follows: "sound", "emerged", "chewed by mammals", "insect holes", "dead". No attempt will be made at this time to analyse these records in detail since the degree of control varies for different localities and for different degrees of infestation of the sawfly. In areas where the cocoons have been numerous for a number of years, 40 or 50 per cent have generally been destroyed by mammals. This percentage does not take into account the number of mature sawfly larvae which are destroyed on the ground before they can spin their cocoons.

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The writer is indebted to Dr. S. A. Graham of the School of Forestry and Conservation, University of Michigan, for helpful criticism during the planning of the field work. Appreciation is also expressed to officers of the Dominion Forest Service, particularly to Mr. J. C. Veness and Mr. E. G. Saunders, who provided the writer with field quarters and the use of study areas at the Acadia Forest Experiment Station during the season.

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SPECIES OF SMALL MAMMALS

Two orders of small mammals are represented in the forest, the Insectivora (moles and shrews), and the Rodentia (mice, voles and squirrels). The species listed here have been captured during the course of the study and we are indebted to Dr. R. M. Anderson of the National Museum of Canada for identifications.

The cinereous shrew, *Sorex cinereus cinereus* Kerr, was found to be the most common insectivore in the spruce forests of New Brunswick and the Gaspé. The short-tailed shrew, *Blarina brevicauda pallida* Smith in New Brunswick and *B. b. talpoides* (Gapper) in Gaspé, was less common in the coniferous stands, particularly in New Brunswick, but was found to be the most common mammal in certain climax hardwood stands. Other species of shrews found to be present but not very common in spruce forests of this region include the following: intermediate pigmy shrew, *Microsorex hoyi intervectus* Jackson, in Gaspé; Thompson pigmy shrew, *Microsorex hoyi thompsoni* Baird, in New Brunswick; northern smoky shrew, *Sorex fumeus umbrosus* Jackson; Nova Scotia water shrew, *Sorex palustris gloveralleni* Jackson. The red-backed vole, *Clethrionomys gapperi ochraceus* Miller, is the most common forest rodent in New Brunswick and the Gaspé, and was somewhat more numerous than the cinereous shrew in 1941. The white-footed mice, *Peromyscus maniculatus abietorum* Bangs and *P. leucopus* ssp,* were found to be somewhat less numerous in most stands. The forest meadow vole, *Microtis pennsylvanicus fontigenus* Bangs, was taken in the centre of the Gaspé but not in New Brunswick. The woodland jumping mouse, *Napaeozapus insignis gaspensis* Anderson in Gaspé and *Napaeozapus insignis insignis* (Miller) in New Brunswick, and the Hudson Bay jumping mouse, *Zapus hudsonius canadensis* (Davies), were taken but neither is very common. The red squirrel, *Tamiasciurus hudsonicus gymnicus* (Bangs), is numerous in this region, and the flying squirrel, *Glaucomys sabrinus macrotis* (Mearns), is present but less common. Both species readily open sawfly cocoons, but they are probably of less importance than the mice and shrews due to their arboreal habits. The northeastern striped skunk, *Mephitis mephitis mephitis* (Schreber), is largely insectivorous, but, like the northwestern chipmunk, *Tamias striatus lysteri* (Richardson), in New Brunswick, the gray chipmunk, *Tamias striatus griseus* Mearns, in Gaspé, and the grey squirrel, *Sciurus carolinensis leucotis* Gapper, is not common in spruce forests in this region very far from settlements and fields.

In general, it appears that the cinereous shrew, the red-backed vole, and the white-footed mouse are the only species which are sufficiently numerous over most of the spruce stands to be of much value in sawfly control. Other species may be locally important in certain sites. For example, at one place in the Gaspé the woodland jumping mouse was trapped in considerable numbers along the sides of a brook. Of the three most common species it is probable that the cinereous shrew is the most important in sawfly control due to the larger percentage of insects in the diet of the insectivores. Studies on the distribution of small lots of marked cocoons in stands which were live-trapped to remove the cinereous shrew but not the rodents, and in nearby stands supporting a normal population of the shrew, show a much more rapid destruction of cocoons in the latter stands. Of the two common forest rodents, it is difficult to say which has the greater value. The red-backed vole is generally more numerous and is more confined to the moss layers where the cocoons are found, since it does not possess the arboreal tendencies of the white-footed mouse. On the other hand, stomach analyses revealed that a larger percentage of the captured whitefooted mice had been feeding on insect material.

P. l. noveboracensis Fischer or *P. l. canadatus* Smith.

All of the forest insectivores and rodents which are captured alive, including all of the common species, showed a preference for sawfly cocoons over any other type of food which was provided, including different grains, meats, nuts, and naturally occurring vegetable material from spruce stands.

POPULATIONS OF SMALL MAMMALS

The accurate measurement of the population numbers of small mammals in forest sites requires some appreciation of the habits of the different species, and particularly a conception of the principles of home range. The home range of an animal, as defined by Burt (4) is "that area about its established home which is traversed by the animal in its normal activities of food-gathering, mating, and caring for young". The average size of the home range varies for different species of small mammals, and even for the different sexes of one species. It is often remarkably large for such small creatures, the average home range of the white-footed mouse in New Brunswick being slightly greater than 1.2 acres. Although wandering movements occur, such as the search of the young for new home sites, it is generally true that once an individual has established its home range it will remain within that area. The home ranges of different individuals often overlap. Assume that we wish to find the population of small mammals in a certain stand, and that we mark off an area of one acre in the stand to serve as a sample. If traps are set over this plot and all of the small mammals caught, it is obvious that we will have trapped not only the mammals resident upon the acre, but also those whose home range extends onto the acre. The resulting figure for population per acre will be many times too high. This procedure has often been used, however, and it accounts for many of the abnormally high population figures which have been reported. The area used for computing the population per acre should include the area covered by the traps plus a strip on all sides equal in width to one-half the average diameter of the home range of the species in question. For a more complete discussion of home range as affecting population studies, the reader is referred to Burt (4).

The home range of small mammals, which must be known before reliable population figures can be obtained, can best be found by live-trapping, numbering (by ear notches), and releasing individuals until they have been caught in all parts of their range. If the traps are also numbered and arranged in grid fashion, the home range of each individual can then be plotted. For examples of this technique, the reader is referred to Burt (4) and Blair (2). This technique also yields considerable information on the breeding habits, life span, and condition of the small mammals, and makes possible a study of the seasonal population trend on an area. However, live-traps are bulky to transport and their use requires a considerable amount of time; other disadvantages have been pointed out by Bole (3), who used the quadrat method with snap-back traps. The writer has found that a combination of both types of traps is the most satisfactory arrangement. Periodic live-trapping, on one area at least, is essential in order to find the home ranges and seasonal population trend of the local species as well as the number of trap-nights necessary to obtain the small mammals present on an area. Snap-back traps are more convenient to use for extensive trapping to find site preferences, etc., and by applying the results obtained from live-trapping the records can be analysed quite satisfactorily.

The live-trapping technique employed by the writer was essentially the same as that described by Burt, except that a new type of live-trap was devised, an account of which will be published elsewhere. Periodic live-trapping on a permanent plot of about six acres revealed that there is a tremendous seasonal fluctuation in the population of small forest mammals. In early spring it is very low, hardly more than one mammal per acre in 1941. It starts to increase in June, when the first litters of young leave

the nests and increases rapidly until early fall (September and October), at which time ten to fifteen specimens may have their homes on a single acre. After breeding ceases in the fall, the population decreases steadily until the following spring, due probably to food shortage and cold weather and to the depredations of bird and mammal predators. Thus, there is almost a complete annual turn-over in poulation. It is obvious, therefore, that the season when trapping is carried out must always be considered in population studies.

Quadrat population trapping with snap-back traps has been carried out in a wide variety of coniferous sites where the sawfly is present.. It will not be attempted at this time to list the results, but a few general conclusions may be mentioned. The nature of the site, and especially the ground cover, is one of the most important factors influencing small mammal populations. The protection from their numerous enemies afforded to small mammals by the presence of ample ground cover, especially fallen trees, old stumps, and other forest debris, is essential to them. The slash from forest thinnings is especially desirable, and the highest populations measured in 1941 were found in stands which had been thinned and the slash left on the ground. Nearby "clean" stands always showed a much smaller population of small mammals. It follows that insect control from small mammals will be slight in stands which have suffered brush burning or other "cleaning up" operations. Dry sites are also preferred, and small mammals were found to be very scarce in several black spruce bog types which were wet throughout the season. The effect of sawflly abundance on the small mammal population is difficult to evaluate from the results of only one season. However, it seems probable that an abundant supply of sawfly cocoons in the moss would favour the increase of the insectivores, which depend largely upon insect food. The rodents would probably be less affected, since they are more or less omnivorous and likely to accept plant or insect food according to availability.

ACTIVITY OF SMALL MAMMALS IN SAWFLY CONTROL

With regard to the daily activity of small mammals, experiments with captive specimens in an automatic activity cage show that the white-footed mouse is nocturnal in habits. The other common species are both nocturnal and diurnal, but in general are more active at night. It is evident, therefore, that the best time to leave traps set is during the night. Activity is cyclic, two or three hours of activity usually being followed by approximately the same period of rest. Activity in destroying sawfly cocoons occurs throughout the summer and early fall. It is most apparent in the fall, as was shown by the periodic examination of small lots of marked cocoons distributed under the moss in spruce sands. This is due to the fact that the population of small mammals is at its peak in the fall, and to the fact that they are busily engaged in gathering and storing food at that time to help tide them over the winter months. This is also the time when the sawfly larvae are dropping to spin their cocoons, although cocoons may be found in the moss throughout the season due to the diapause tendency of the sawfly. It is common to find hoards of cocoons stored by shrews and mice in their runways and under the roots of trees, some of them containing several hundred cocoons. It is doubtful whether small mammals can collect many cocoons from the moss during the winter months when the ground is frozen.

Searching ability is an important factor influencing the value of any predatory animal. The searching ability of small mammals is remarkably high, as was shown by the high percentage of cocoons destroyed when the cocoons were distributed in small marked lots under the moss over fairly large areas in spruce stands. For example, 100 lots of three cocoons each were distributed

over an area of about seven acres on October 23. One month later, 91 of the lots had been carried off by shrews and mice.

Experiments show that the rodents are usually not capable of distinguishing sound cocoons from dead cocoons, or cocoons from which parasites have emerged. Cocoons from which parasites of the genus *Exenterus* have emerged, however, are not so liable to be opened as those with the smaller emergence holes of *Microplectron fuscipennis* Zett. Cocoons with the large emergence hole of the sawfly itself are rarely chewed. This should be given consideration in analyses of cocoon population figures and the calculation of percentage of parasitism, since cocoons actually destroyed by parasites or by adverse physical factors may be included in the "chewed" category. On the other hand, the insectivores, as evidenced mainly by experiments with the short-tailed shrew, show a remarkable sense of distinction and rarely open dead cocoons or those which have been emptied by parasites. Whether shrews open cocoons containing living parasites, I do not yet know. This selection appears to be made largely by the olfactory sense; although the weight of the cocoon may sometimes play a part. I have watched a shrew pick out a good cocoon unerringly from the center of a pile of dead ones. Dead cocoons are picked up occasionally, but quickly dropped before they are opened. The fact that many of the hoards of cocoons found in runways contain only sound cocoons further strengthens the argument that shrews are more important than mice and voles in sawfly control. For this reason, I do not wholly agree with the procedure used by Hardy (7) in his treatment of the interference of various sawfly control factors, since it assumes that this sense of selection does not exist in either shrews or rodents.

The nature of the openings chewed in cocoons does not appear to be sufficiently distinctive to permit a definite identification of the species of small mammal responsible for the opening. In all cases the shrew or rodent first bites a hole in the cocoon (usually in one end) large enough to permit the extraction of the enclosed larva (or other stage of the sawfly). The empty cocoon is then discarded and the larva eaten. In eating the larva, the head and the part of the thorax bearing the legs are often rejected. This affects stomach analysis studies of small mammals and tends to make the results conservative as far as the percentage of insect food is concerned.

SUMMARY

The importance of small mammals as factors in the natural control of destructive forest insect pests has not been generally appreciated by foresters and entomologists. In Eastern Canada it is common to find as high as 40 to 50 per cent control of the European spruce sawfly effected under epidemic conditions by small forest mammals. The cinereous shrew, the red-backed vole, and the white-footed mouse are the most abundant mammals in the coniferous forests of this region, the cinereous shrew being the most effective in sawfly control. Population studies show that there is a considerable seasonal fluctuation in the population of small mammals. The character of the site has an important influence on the population of shrews and rodents, dry sites with abundant protective ground cover being preferred. Little insect control by mammals can be expected in stands which have suffered the burning of brush or other "clean-up" procedures. The activity of small mammals in searching for sawfly cocoons is greatest in the fall when the mammal population is high and the hoarding of cocoons is a common practice. The searching ability of small mammals is remarkably high. The shrews, but not the rodents, have the ability of recognizing sound cocoons before they open them.

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NOTES ON THE EARLY STAGES OF TWO *EUPITHECIA* SPECIES (LEPIDOPTERA) *

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Eupithecia filmata Pears.

The spring of 1941 in the Ottawa region, being continuously warm and dry, was very favorable for early species of Lepidoptera. *Filmata* Pears., usually a great rarity, was taken in considerable numbers in a spruce grove, adjacent to a cedar swamp, about 10 miles southwest of Ottawa. From several females eggs were obtained in late April; these hatched in about 8-10 days, the young larvae thriving excellently on the young buds of spruce, into which they frequently bored their way. Growth was rapid and by the end of May pupation was taking place in a light web under spruce needles. The pupae aestivate and hibernate and the adults emerge with the first warm spring days of the following year. The following notes on the life-history were made.

Egg. When first laid white, later yellowish; oval, finely sculptured, laid on its long axis on upper or underside of needle or on bark at base of needle.

1st *Instar.* Head upright, pale brownish. Body thin, rather elongate, cylindrical, pale yellowish with tubercles minute, blackish, bearing very short setae.

2nd *Instar.* Very similar to preceding. In late stages certain individuals show traces of dark markings of next instar.

3rd *Instar.* Head pale fleshy. Body flatter and segments transversely wrinkled, crossed by numerous depressions forming 5-6 subsegments. Color a pale yellowish with broad brown dorsal line and brown lateral stripes, the lower edges of these becoming diffuse in spiracular area. Pale areas show as subdorsal and spiracular stripes, the latter meeting across the prolegs of 10th segment. Ventrally pale centrally with broad brown lateral stripes.

4th *Instar.* Head light flesh or greyish, somewhat mottled with light purple-brown on apices of lobes. Body pale yellowish or greenish or pale fawn. The dorsal brown stripe of previous instar varies in color from light brown to black-brown and forms more or less diamond-shaped patches on central portion of abdominal segments I-VI. The lateral brown stripe is pale but is accentuated

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by a deep black-brown streak in central portion of each segment, below diamond patches. Area below this stripe shaded with light brownish followed by a stigmatal stripe of ground color (yellowish). Beneath as previously. Body rather flattened, weakly shagreened and cut into numerous subsegments. Appears somewhat bristly, owing to short black tubercular setae.

When fully mature the color is very variable, shading from pale yellow-green to red-brown, the lighter colored specimens being best marked. Dorsal markings and lateral streak at times almost black and often all that remain of the maculation. In red-brown specimens the pale yellow spiracular and subdorsal streaks show up very clearly.

Eupithecia gibsonata Tayl.

In early June adults of this species were numerous on the trunks of cedar at Queen's Park, Aylmer, Que., on the Ottawa river a few miles above Ottawa. Enclosed in a tin with the foliage of various conifers, females laid their light yellowish eggs in preference on cedar. The young larvae, on hatching in about eight days, fed exclusively on cedar and refused other conifers. When first hatched they are rather chunky and entirely pale yellowish; they are very sluggish and feed up extremely slowly, becoming somewhat greener in color after the first moult, but still immaculate. During my absence from Ottawa in July and August a certain proportion of the larvae were brought to maturity by one of my assistants and mature larvae also preserved in alcohol. In late August beating among the cedars from which the adults had been obtained in the spring resulted in the securing of several full-grown larvae which matched the alcohol material exactly.

Mature larvae are green with *definitely broken subdorsal and subspiracular white stripes,* the former faint and broken in the median portion of each segment by quadrate blackish-green patches, a pair to each segment; the latter broader and quite distinct, broken on anterior portion of segment by a type of dark patch very similar to that of the subdorsal line. There are tinges of yellowish along the flange and the posterior portion of each abdominal segment. McGuffin's recent description of this larva (1942, Can. Ent. 74:152), with which an excellent figure is given, confirms my notes.

It was possible to compare these cedar-feeding larvae with other larvae, beaten from juniper, and to which I have previously (1929, Can. Ent., LXI, 64) referred under the probably erroneous name of *helveticaria* Bdv. The juniper feeders differed consistently from those on cedar in possessing *unbroken white subdorsal and subspiracular stripes,* generally bordered ventrally by a somewhat darker green shade than the body-color; a faint darkish dorsal line was also present. These larvae matched excellently with Dietz' figure (Biol. der Eupithecien) of the larva of the European *arceuthata* Fr., also a juniper-feeder, and showed the same differences from our cedar-feeders as Dietz mentions as existing between *arceuthata* and the Alpine *helveticaria* Bdv., also apparently a juniper-feeder.

European workers do not seem to regard these larval differences as of specific value but in the case of our North American forms I am inclined to believe that the food-plant difference, combined with larval distinctions, indicates two closely allied species and as such I prefer to regard them. I use, therefore, the name *gibsonata* Tayl. (*chagnoni* Swett) for the cedar-feeder and *arceuthata* Fr. (which should be added to our lists) for the juniper-feeder.

I can find no definite genitalic differences between the adults and the maculation is practically identical; *gibsonata,* however, is distinctly larger and of a rather paler, more clay-brown color than *arceuthata,* what Swett, in his description of *chagnoni,* called 'light ash with reddish brown shadings'.

THE REDISCOVERY OF *EUMENIS STRECHII* EDW. (LEPIDOPTERA, RHOPALOCERA)

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While collecting in Nevada during the summer of 1935 in the Toiyabe Range of Mountains, which rise to an elevation of almost 12,000 feet, and the southern end of which is approximately 75 miles north of Tonopah, I came across a colony of butterflies that have ever since caused me much speculation. From this colony and from another in the nearby Toquima Range, just across the Big Smokey Valley, I secured forty-seven specimens all of which are similar to one another but distinctly different from any other satyrid that I have encountered.

After a careful study of the descriptions of the various races of the genus *Eumenis,* I have come to the conclusion that this is the insect referred to in Edwards' description of *Chionobas stretchii,* published in 1870. (Trans. Amer. Ent. Soc., III, 192). This name has stood long in synonymy, no doubt for the reason that no specimens have been found in the interval between that time and the present, and therefore the types were likely presumed to be merely an aberrational phase of *Eumenis ridingsii* Edw. Another misfortune that served to increase the obscurity of this race was the fact that the types, in the collection of Behr at San Francisco, were destroyed in the great fire of 1906; thus almost the last vehicle of identification was lost. Fortunately however, Edwards, as was usually his custom, left a very lucid description of this insect. Since "pioneer days" when the types, consisting of one male and one female, were collected by the Wheeler Geological Expedition, this butterfly has not been known except for the two lost types. Edwards gave the type locality merely as "Nevada". It is unlikely that he knew a more explicit location as the area of discovery was a great, unsettled, almost unexplored region at the time of the Wheeler Survey. Many landmarks that we now know did not exist in those early days; therefore many of the records suffered, and frequently locations were only recorded in a broad and indefinite manner. Edwards' description mentions the fact that small, black, apical ocelli, with white centers, were present on the second spots on the upper side of the primaries of *stretchii.* I find that this is an extremely variable character and, as in *E. ridingsii* Edw., it is more often absent than present.

Since my rediscovery of *E. stretchii,* I have studied many series of *Eumenis,* from California to Colorado, the extent of its range. In all of these I have found but two or three specimens that approach *stretchii* and these were in a long series from Colorado. These two or three specimens can only be considered as intergrades between *stretchii* and the parent race, *ridingsii* Edw., as they exhibit to a degree the ochery-brown tendency. It would be the limit of inconsistency to retain *stretchii* as a synonymic name of *ridingsii* on that premise, which, if tolerated would relegate to synonymy a considerable portion of our now recognized racial names of Lepidoptera. Intergrades or transitional individuals are often present in many of the best established races. The ochrey-brown of *E. stretchii* presents a wide differential from the gray of *ridingsii,* so I propose that the name *Eumenis stretchii* Edw. be lifted from synonymy and assigned racial status.

Referring to *Eumenis dionysus* Scud., I should like to record that I share with many careful students of Lepidoptera the opinion that it should be considered not a species or even a race but should be given as a form of ***ridingsii.*** I am unable to learn of any locality where it attains the semblance of constancy. This form occurs persistently throughout the range of *ridingsii* along with legions of intermediate individuals. The types of *dionysus* are from a district that has produced many specimens of *ridingsii.*

With the above in view, I am placing two specimens of *Eumenis stretchii* that I shall designate as neotypes, one male and one female, in the Canadian National Collection at Ottawa, Canada, and two other specimens in the United States National Museum at Washington, D. C.

NOTE

APPARENT NEGATIVE GEOTROPISM IN THE DOUGLAS FIR BARK BEETLE

In a standing tree, the galleries of the Douglas fir bark beetle, *Dendroctonus pseudotsugae* Hopkins, are projected from the entrance holes toward the top of the tree. In an attempt to ascertain whether this habit may be due to negative geotropism or to some structural or physiological factor in the tree, the following small scale experiment was undertaken.

Three trees were felled so that each rested at a different angle, the downward slope in every case being from the base of the tree toward the top. A standing tree nearby was used as a check.

Results are shown in the table below.

Tree No.	Inclination (base to top)	Galleries examined	No. projected toward top	No. projected toward base
1	standing tree	50	50	0
2	−5°	20	9	11
3	−15°	20	1	19
4	−20°	20	1	19

Although based on an admittedly small number of observations, the above data seem to indicate that the angle formed by the felled tree and the ground line plays an important part in determining whether the galleries will be projected up or down the trunk. The beetles are not sensitive to a slope as small as 5°, since in tree No. 2 the number of galleries projected each way was about equal. A close study of the galleries in this tree revealed considerable indecision on the part of the beetles regarding the orientation of the tunnel. This was evidenced by the winding back and forth of some galleries at the start before a definite direction was chosen. On the other hand, a slope of 15° or over seems to produce a very definite reaction, since in trees Nos. 3 and 4 nearly all of the galleries were projected toward the base, instead of toward the top as in standing trees.

The position of the entrance holes with regard to the upper or lower side of the log did not seem to influence the beetles to any appreciable extent, and all galleries were projected either upward or downward following the general direction of the grain. It seems legitimate, therefore, to conclude that the beetles have a tendency to follow the structure of the wood while exhibiting, at the same time, a rather definite negative geotropic response.

Whether or not the ease with which borings can be expelled from a vertical gallery should be considered in explaining the normal habit of *D. pseudotsugae* is, to say the least, a moot question and seems to postulate on the part of this beetle a degree of "intelligence" not possessed by many of its congeners.

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NEW NEARCTIC CRANE-FLIES (TIPULIDAE, DIPTERA). PART XVII.

BY CHARLES P. ALEXANDER,

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The preceding part under this general title was published in 1941 (Can. Ent., 73: 206-213). In the present instalment, I am discussing species included in extensive series of these flies taken by Mr. H. Elliott McClure at Fort Churchill, Manitoba; by Dr. Mont A. Cazier in California and Nevada; by Mr. and Mrs. John L. Sperry in Montana, Wyoming and New Mexico; by Dr. and Mrs. Henry K. Townes in Washington; and by Mr. John W. Zukel in Idaho. My deepest thanks are extended to all of the above entomologists for the privilege of retaining the types of the new species and for this invaluable co-operation in making known the large and intricate tipulid fauna of the Rocky Mountains and Pacific States and Provinces. The long-term survey of the crane-flies of Western North America is now well under way and very many surprising discoveries have been made.

Prionocera rostellata churchilliana n. subsp.

Male. Length about 12 mm.; wing 11.5-12 mm.

Female. Length about 13-15 mm.; wing 12 mm.

Frontal prolongation of head short and stout, with short stout nasus; extreme outer margin of prolongation orange; palpi black. Antennae black throughout; flagellar segments only moderately produced. Head black, sparsely pruinose; anterior vertex broad.

Pronotum grayish pruinose, the scutellum and lateral pretergites yellow. Mesonotum gray pruinose, the parascutella, lateral border of mediotergite, and all of the katapleurotergite excepting a dark line above the root of halteres yellow; praescutum with three more darkened stripes that are poorly defined against the ground; in cases, the median stripe divided by a gray central vitta. Pleura chiefly gray pruinose; dorsopleural region buffy yellow; metapleura extensively variegated with yellow. Halteres dark brown, the base of stem restrictedly yellow. Legs with the coxae darkened, gray pruinose; trochanters obscure yellow; legs light brown, the tarsi passing into black. Wings with a weak brown tinge, the costal border a very little darker; stigma pale yellow, inconspicuous; veins brown, more brownish yellow in the brightened areas.

Abdomen gray, the lateral borders of the tergites broadly yellow; a more or less distinct brown mid-dorsal stripe on tergites; hypopygium brownish yellow to yellow. Male hypopygium with the lateral tergal lobes very broad, their lateral portions obtusely rounded, without indication of an oblique carina; median area of tergal border truncate, the notch formed subequal in width to either tergal lobe.

Habitat. Manitoba.

Holotype. ♂, Fort Churchill, 1941 (H. E. McClure, No. 17 CH 41). *Allotopotype.* ♀, (McClure No. M 22). *Paratopotypes,* 3 ♀♀, one pinned with cast pupal skin.

This *Prionocera* is very different from the various species so far discovered in the Canadian Arctic and I must consider it as being a subspecies of *rostellata* (Doane), described from the mountains of Colorado. As usual in the genus, the conformation of the ninth tergite of the male offers the best characters.

Prionocera rostellata prominens n. subsp.

As in the typical form but differing in details of structure of the male hypopygium. The ninth tergite has the lateral lobes much more conspicuous, subangular, with a ridge or carina extending obliquely down the face of lobe from the caudo-lateral angle.

Habitat. Manitoba.

Holotype. ♂, Fort Churchill, 1938 (H. E. McClure, No. 3 CH 38).

Tipula (Trichotipula) cazieri n. sp.

Size very small (wing, ♂, under 7.5 mm.); mesonotal praescutum dark brown with a broad, dark gray, median stripe; posterior sclerites of mesonotum with a continuous yellowish white central stripe that is bordered laterally by black; tips of femora narrowly brownish black; wings without dark pattern except for the brown stigma; sparse macrotrichia in outer ends of cells R_5 and M_1, male hypopygium with the inner dististyle directly produced to an obtuse point.

Male. Length about 8 mm.; wing 7.1 mm.; antenna about 3 mm.

Frontal prolongation of head pale yellow above, darker on sides; nasus very long, tufted with yellow setae; palpi black. Antennae with scape and pedicel pale yellow, flagellum black; flagellar segments cylindrical, the basal swellings not indicated; verticils shorter than the segments. Head yellowish white; anterior vertex broad, the tubercle low; lateral portions of posterior vertex strongly infuscated.

Pronotum yellow, darkened sublaterally. Mesonotal praescutum with the ground color dark brown, with a broad, dark gray, median stripe, the lateral stripes very ill-defined and encroached upon by the dark ground color; humeral and lateral borders of praescutum, with the pretergites, yellowish white; posterior sclerites of notum dark gray, variegated by brownish black; a continuous yellowish white central stripe begins on the extreme posterior portion of praescutum, extending to three-fourths the length of the mediotergite where it narrows to a point; pale stripe bordered laterally by a more intensely blackened margin; parascutella dark. Pleura yellowish white, conspicuously patterned with brownish gray, especially on anepisternum, ventral sternopleurite, dorsal and ventral pteropleurite, and on the ventral pleurotergite, the dark color about equal in extent to the pale ground; dorsopleural membrane whitened. Halteres infuscated, base of stem restrictedly yellow. Legs with the coxae weakly infuscated; trochanters obscure yellow; femora obscure yellow, the tips very narrowly brownish black, the amount subequal on all legs; tibiae brown, the tips darker; tarsi brownish black; claws (♂) simple. Wings with a strong and almost uniform brownish tinge, the centers of the cells beyond cord a little streaked with dusky, this bordered on either side by paler; prearcular field yellowish; stigma brown, oval, distinct; ante- and post-stigmal whitish spots conspicuous; a very restricted isolated obliterative area from the extreme outer end of cell *R*, across base of cell 1*st* M_2 into extreme base of cell M_3; veins brown. Macrotrichia of cells very restricted, including series in centers of outer ends of cell R_5 and M_1, stigma with about three trichia. Venation: *Rs* arcuated, shorter than cell 1*st* M_2; cell M_1 about four times its petiole; cell 1*st* M_2 long and narrow; cell M_4 deep; M_3+_4 shorter than basal section of M_1+_2.

Abdominal tergites extensively obscure light yellow in central portion, with conspicuous sublateral brown stripes that are very narrowly interrupted on the basal rings; lateral borders of tergites pale; sternites obscure testaceous yellow, the outer segments weakly darkened; hypopygium brown. Male hypopygium with the caudal border of tergite with a broad U-shaped notch, the border with a very sparse armature of delicate and spinous setae. Inner dististyle only a trifle longer than the outer style, narrowed outwardly, the obtuse tip not bent at a strong angle to the remainder of style; basal portion of inner style with a group of strong curved setae, the narrowed outer portion with numerous straight setae of various lengths, a row of four or five near outer border longest.

Habitat. Southern Nevada (Clark Co.).

Holotype. ♂, Kyle Canyon, Mount Charleston, May 25, 1940 (Mont Cazier).

I take great pleasure in naming this interesting fly in honor of the collector, to whom I am indebted for several western Tipulidae of unusual interest. This is one of the smallest species of the genus known in the entire World, being much smaller than any hitherto made known from the Nearctic fauna. The species is closest to *Tipula* (*Trichotipula*) *apache* Alexander, differing in the tiny size, details of coloration, and the structure of the male hypopygium, especially the tergite and inner dististyle..

Tipula (Lunatipula) sperryana n. sp.

General coloration dark gray, the praescutum with four entire darker stripes; antennae (♂) relatively long, black throughout; legs chiefly blackened, the femoral bases brightened; wings grayish subhyaline, cells *C* and *Sc*, together with a seam along vein *Cu*, darker; stigma small, brown; abdominal tergites black, the lateral and posterior borders yellow, this becoming very extensive on outer segments, the hypopygium and preceding segment almost uniformly yellow; male hypopygium with the ninth tergite trilobed, the median lobe small, densely setuliferous; eighth sternite unarmed.

Male. Length about 13-14 mm.; wing 13.5-14 mm.; antenna about 6 mm.

Frontal prolongation of head black, the dorsal surface pruinose, with conspicuous black setae; nasus distinct; palpi brownish black. Antennae black throughout; relatively elongate (♂), a little less than one-half the length of wing; flagellar segments moderately incised; verticils shorter than the segments. Head brownish gray, the front and narrow orbits clearer gray; head provided with abundant long black setae.

Pronotum dark gray, the lateral portions of scutellum restrictedly brightened. Mesonotal praescutum brown with four entire brownish black stripes; setae yellow, conspicuous; posterior sclerites of notum dark gray. Pleura gray, the dorsopleural membrane and an area surrounding the posterior thoracic spiracle yellowish. Halteres brown, the knobs a little darker. Legs with the coxae dark gray; trochanters black; femora brownish yellow, the tips broadly blackened, more extensive on the fore legs where the distal third or more is included, on the middle and posterior pair involving, in cases, the outer fourth, in other cases much more extensive: tibiae and tarsi black; claws simple. Wings grayish subhyaline, almost immaculate; stigma small, brown; cells *C* and *Sc* a little darkened, especially the latter; a scarcely indicated dark seam on anterior cord; a distinct brown wash along vein *Cu*, involving cell Cu_1 and adjoining portions of cell *M;* veins dark brown, *Sc* and the prearcular veins more brownish yellow. Venation: *Rs* more than one-half longer than *m-cu;* cell M_1 normally petiolate, in the holotype sessile; *m-cu* at or just beyond the fork of M_3+_4, the basal section of M_4, when present, vertical.

Abodmen with tergites black, the basal one more pruinose; lateral tergal borders broadly obscure yellow, the posterior margins of the second and succeeding tergites yellow, very narrow on the basal segments, becoming more extensive outwardly, the seventh tergite with about the outer half yellow; eighth and ninth tergites uniformly yellow; sternites blackened medially, the lateral borders of the exposed outer segments very broadly yellow; ninth sternite with conspicuous black spots or dashes. Male hypopygium with the ninth tergite conspicuously trilobed, the lateral lobes longer and broader than the median one, their subglabrous tips narrowly obtuse; median lobe slender, conspicuously setulose. Outer dististyle a moderately broad pale spatula. Inner dististyle broadly flattened, the margins obtuse; outer basal lobe moderately large, its apex more

sclerotized and weakly toothed. Basistyle produced at apex into a triangular point or blade; mesal face of basistyle bearing a cylindrical lobe tipped with abundant long yellow setae. Eighth sternite unarmed.

Habitat. Wyoming-Montana Border.

Holotype. ♂, Beartooth Mountains, Frozen Lake, altitude about 10,000 feet, August 9, 1941 (J. L. & G. H. Sperry). *Paratopotypes,* 2 ♂♂, with type; 3 ♂♂, altitude about 10,800 feet, August 1, 1942 (J. L. & G. H. Sperry). *Paratypes,* Quad Creek, Beartooth Mountains, altitude 10,000-10,200 feet, August 15-19, 1942, and Frozen Lake, August 13, 1942 (J. L. & G. H. Sperry; Dan Lindsley), several additional specimens.

I take very great pleasure in naming this interesting alpine *Tipula* in honor of the Sperrys, most capable collectors and students of the Lepidoptera. The paratopotypes were in association with *Tipula* (*Oreomyza*) *neptun* Dietz, another arctic-alpine species of the genus. I consider that the nearest described relative of the present fly is *Tipula* (*Lunatipula*) *disjuncta* Walker, of northern and northeastern North America, which differs in all details of coloration of the body and appendages, and in the details of structure of the male hypopygium.

Tipula (Lunatipula) polycantha n. sp.

General coloration brownish gray, the praescutum with four conspicuous grayish brown stripes that are narrowly bordered by darker brown; basal segments of flagellum bicolored; femora obscure yellow, the tips narrowly brownish black; wings medium brown, conspicuously cross-banded by two narrow whitish areas, the first before level of origin of *Rs,* the second at cord; male hypopygium with the outer dististyle conspicuously expanded into an obliquely triangular blade; eighth sternite large and sheathing, the posterior margin on either side armed with from seven to nine strong, flattened, paddle-like spines, their tips truncate.

Male. Length about 18 mm.; wing 20 mm.; antenna about 4.8 mm.

Frontal prolongation of head light brown, very sparsely pruinose; nasus elongate, tufted with golden setae; palpi dark brown. Antennae (♂) of moderate length, if bent backward extending approximately to the wing-root; scape and pedicel obscure brownish yellow; basal flagellar segments bicolored, dark brown basally, the remainder yellow; third and succeeding flagellar segments more uniformly dark brown; flagellar segments moderately incised; verticils longer than the segments. Head light gray, slightly infuscated behind each antennal base and on the low vertical tubercle; a capillary brown median vitta on vertex.

Pronotum brownish gray, dark brown medially. Mesonotal praescutum brownish gray with four conspicuous grayish brown stripes that are narrowly bordered by darker brown; intermediate pair slightly widened and approaching one another at near one-third the length of sclerite; posterior segments of notum brownish gray; each scutal lobe with two dark brown areas, the posterior one much larger; scutellum and mediotergite with a capillary brown median line. Pleura chiefly pale, sparsely pruinose; dorsopleural membrane buffy. Halteres with stem obscure yellow, brighter at base; knob dark brown, its apex a trifle paler. Legs with the coxae brownish yellow; trochanters obscure yellow; femora obscure yellow, the tips narrowly brownish black, the amount subequal on all legs; tibiae and basitarsi light brown, the outer tarsal segments passing into black; claws (♂) with a single conspicuous tooth. Wings medium brown, handsomely crossbanded by two narrow whitish areas, prearcular and costal fields more yellow; first crossband before level of origin of *Rs,* extending from *R* to the posterior margin at end of vein *2nd A,* interrupted by the dark cell *Cu,* sending a spur distad in cell *R* to the origin of *Rs;* second band at cord, extending from

vein *R* to the posterior margin in cell M_4; an incomplete white band near bases of cells *Cu* to *2nd A;* outer ends of cells R_3 and R_5 whitened, with subbasal spots in cells M_1 and *2nd* M_2, more or less distinctly connected with the pale band at cord; extreme outer end of cell M_3 whitened; stigma brown, its proximal end paling to yellow; veins brown, paler in the more yellowish areas. Venation: R_1+_2 entire; *Rs* fully twice the length of *m-cu.*

Abdominal tergites weakly infuscated, the lateral and posterior borders paler; sternites more brownish yellow, the lateral portions clearer yellow; hypopygium large, chiefly brownish yellow. Male hypopygium with the caudal border of tergite narrowed outwardly, with a deep rectangular notch, the lobes thus formed flattened, with gently rounded mesal edges; base of notch very slightly produced; dorsal surface of tergite with a conspicuous median furrow, the edges of which bear numerous strong spinous setae. Outer dististyle conspicuously expanded into an obliquely truncated blade. Inner dististyle compact, the crest produced backward into a pale tail-like blade; outer basal lobe pale, relatively simple, narrowed outwardly, the outer face with several very long erect setae, the base with a dense group of shorter delicate setae. Gonapophyses appearing as conspicuous curved blades, narrowed to long spinous points. Eighth sternite very conspicuous, large and sheathing, the posterior margin of either side armed with from seven to nine strong flattened paddle-like spines, their tips truncate, decussate at midline with their mates of the opposite side of incision.

Habitat. New Mexico (Sandoval County).

Holotype. ♂, Frijoles Canyon, Bandolier National Monument, June 22, 1942 (J. L. & G. H. Sperry).

This very distinct crane-fly requires no comparison with any other species so far made known. The wing-pattern is somewhat as in *Tipula* (*Lunatipula*) *vittatipennis* Doane, 1912 (*albovittata* Doane, 1901, preoccupied) but the two species are entirely distinct in other regards.

Pedicia (Tricyphona) townesiana n. sp.

Size relatively small (wing, ♂, 8 mm.); general coloration of mesonotum pale brownish yellow, without markings; antennae very short, subbasal flagellar segments short and crowded; wings subhyaline; R_4+_5 unusually long, about one-half as long as either R_4 or R_5; cell M_3 very deep, vein M_3+_4 correspondingly shortened; male hypopygium with the interbasal rod long and slender, with numerous strong scattered setae over most of the length.

Male. Length about 7 mm.; wing 8 mm.; antenna about 0.7 mm.

Rostrum and mouthparts obscure yellow; palpi darker. Antennae (♂) very short; scape yellow, remainder of organ brownish black; subbasal flagellar segments short and crowded. Head obscure brownish yellow, the surface very sparsely pruinose; center of the broad vertex weakly darkened.

Pronotum yellow. Mesonotum very pale brownish yellow, without markings. Pleura more reddish yellow. Halteres with stem yellow, knob weakly darkened. Legs with coxae reddish yellow; trochanters yellow; femora, tibiae and basitarsus obscure yellow, the tips weakly darkened; outer tarsal segments more uniformly dark brown. Wings relatively narrow, subhyaline, the restricted prearcular field pale yellow; stigma very pale brown, inconspicuous; veins dark brown, more yellow in the prearcular field. Venation: *Rs* strongly arcuated to feebly angulated, shorter than R_2+_3; R_2 nearly perpendicular, subequal to R_1+_2; *r-m* connecting with *Rs* very shortly before the fork; R_4+_5 unusually long, about two-thirds R_2+_3 or approximately one-half of either R_4 or R_5; *m* beyond fork of M_1+_2 on M_2, cell *1st* M_2 thus long and narrow; M_3+_4 very short, cell M_3 very deep, vein M_4 alone longer than *Rs; m-cu* at near two-thirds the length of M_3+_4; cell *2nd A* relatively narrow.

Abdominal tergites dark brown medially, yellow on sides; basal sternites yellow; outer segments, including hypopygium, uniformly brownish black. Male hypopygium with the tergite extensive; caudal margin truncate with two widely separated rounded knobs. Basistyle with the interbasal rod long and slender, only a little shorter than the basistyle itself, strongly arcuated; apex a trifle expanded just before the acute terminal pale spine; surface of interbase with numerous strong scattered setae for almost their entire length. Dististyle very low and appressed to apex of basistyle, set with abundant short blackened pegs.

Habitat. Washington.

Holotype. ♂, Mount Rainier, altitude 5,300 feet, August 15, 1940 (H. & M. Townes).

This unusually distinct species is named in honor of the collectors, Dr. and Mrs. Henry K. Townes, to whom I am deeply indebted for specimens of Tipulidae from the Southern Appalachians and from the Pacific Coast. The fly is entirely distinct from any of the numerous Nearctic species of the subgenus so far discovered The shape of the interbase is more as in certain species in Eastern Asia, as *Pedicia* (*Tricyphona*) *formosana* (Alexander) and *P.* (*T.*) *yakushimana* (Alexander) but in all other regards there is no close relationship.

Dactylolabis adventitia n. sp.

Mesonotal praescutum dark gray with four narrow dark brown stripes; wings yellowish, heavily patterned with brown; dark cloud at origin of *Rs* crossing cell *R* into cell *M*, not quite reaching vein *Cu* behind; setae of costal fringe long and abundant; a supernumerary crossvein in cell R_3; cell 1*st* M_2 relatively small; *m-cu* at or very close to fork of *M*.

Male. Length about 6.5-7 mm.; wing 8-8.2 mm.

Female. Length about 6.5-7 mm.; wing 7-8 mm.

Rostrum and palpi black. Antennae with scape brownish black; remainder of organ black; flagellar segments oval, the longest verticils subequal to or shorter than the segments. Head brownish gray; setae and setigerous punctures conspicuous.

Pronotum chiefly brown, restrictedly pruinose. Mesonotal praescutum dark gray with four narrow but conspicuous dark brown stripes, the surface entirely opaque; scutum dark gray, the lobes with poorly differentiated dark brown areas; scutellum darkened basally, obscure testaceous yellow on posterior portion; postnotum heavily gray pruinose. Pleura dark brown, dark gray pruinose; dorsopleural membrane yellowish brown. Halteres uniformly pale yellow. Legs with the coxae brownish gray basally, the outer portion more yellowish; trochanters brownish yellow; femora obscure yellow, the tips very narrowly and weakly darkened; tibiae pale brown; tarsi brownish black. Wings yellowish, heavily patterned with brown, the spots arranged more or less as in *montana* and allies; dark cloud at origin of *Rs* crossing cell *R* into cell *M*, not quite reaching vein *Cu* behind; cells beyond cord and in the Anal field more or less washed with brown; veins brown, paler in the interspaces, especially in the costal field. Setae of costal fringe long and abundant in both sexes. Venation: $R_2+_3+_4$ short to very short; a supernumerary crossvein in cell R_3, usually just beyond the level of R_2, in cases a short distance basad of this point; cell 1*st* M_2 relatively small, subequal to or shorter than vein M_4 beyond it; *m-cu* at or very close to fork of *M*, in cases a short distance before this point.

Abdomen dark brown, the outer segments, including hypopygium, more blackened. .

Habitat. Idaho (Nez Perces Co.).

Holotype. ♂, Lewiston, April 23, 1938 (J. W. Zukel). *Allotopotype*, ♀. *Paratopotypes*, 1 ♂, 1 ♀.

Dactylolabis adventitia is closest to *D. supernumeraria* Alexander, of northeastern North America, differing conspicuously in the wing pattern and venation. This latter species has *Rs* and cell 1*st* M_2 considerably longer than in the present fly. In southern Europe, various other species of the genus occur that have a supernumerary crossvein in cell R_3, as in the case of the two Nearctic forms above mentioned.

Dactylolabis hortensia sparsimacula n. subsp.

Female. Length about 11 mm.; wing 9.5 mm.

Similar to typical *hortensia* (Alexander), described from British Columbia (Proc. Acad. Nat. Sci. Philadelphia 66:591-592; 1914), differing especially in the larger size and in details of coloration.

Head and pronotum clear ashy gray. Mesonotal praescutum with the interspaces conspicuously grayish yellow, contrasting conspicuously with the clear gray of the remainder of notum; praescutal stripes narrow, polished black, the median one on cephalic portion slightly divided by a line of yellow pollen; scutum similarly grayish yellow pollinose, the lobes vaguely marked with darker but not polished; posterior sclerites of notum and the pleura clear gray. Halteres pale yellow throughout. Legs with all coxae gray pruinose; femora brownish yellow, the tips slightly more darkened; tibiae and basitarsi brownish yellow, the tips very narrowly but abruptly darker. Wings with the ground color yellow, the prearcular field brighter yellow; a restricted but relatively conspicuous pale brown pattern, including areas at origin of *Rs*, cord, outer end of cell 1*st* M_2 and fork of M_{1+2}, in certain areas best indicated by a deepening in color of the veins. Venation: R_2 more nearly perpendicular than in typical *hortensia; m-cu* about one-third its length before the fork of *M*.

Abdominal tergites dark brown to brownish black; sternites yellow.

Habitat. Washington.

Holotype. ♀, Mount Rainier, altitude 5,700 feet, July 8, 1940 (H. & M. Townes).

In the typical form, the ground color of the mesonotum is uniformly light gray, without the distinct yellow pollen of the present fly; coxae yellow; wings unpatterned.

A NEW SPECIES OF *PSEUDEXENTERA* FROM APPLE, WITH NOTES ON ALLIED SPECIES (OLETHREUTIDAE, LEPIDOPTERA) *

BY T. N. FREEMAN,

Ottawa, Ont.

During the past two summers, we have captured and reared a species of *Pseudexentera* Heinr. which was breeding in large numbers on the wild apple trees of the Ottawa district. It was also commonly noticed flying around the hawthorn (*Crataegus* sp.) of this area, and while it was not reared from this plant it is probable that *Crataegus* is another food-plant. This moth was also recognized as new by Dr. W. T. M. Forbes from material reared from the apple orchards of the Ithaca district, New York, by D. E. Greenwood and the late J. H. Comstock. To avoid duplication of effort, Doctor Forbes kindly sent us his accumulated material for study, and the following description is offered:

*Contribution No. 2202, Division of Entomology, Science Service, Department of Agriculture, Ottawa.

Pseudexentera mali n. sp.

Male. Palpi outwardly, head and thorax, greyish-brown. Inwardly the palpi are whitish. Fore wing without much pattern; basally dark greyish-brown with an admixture of golden brown scales which predominate along the posterior margin and in the apical third. In this latter area the golden brown is interrupted by plumbeous patches and contains a few black scales in the tornal region; fringe grey, darker apically. Hind wing light smoky with paler fringe which shows a dark basal line. Expanse 16 mm.

Female. Palpi, head and thorax as in male. Fore wing with dark brown basal patch sharply angled outwardly, its outer margin well defined on the dorsal half but rather obscure on the costal half. Beyond this basal area, on the dorsal margin, is a large greyish-white irregularly quadrate patch, followed outwardly by a brownish area containing a few black bars, which in turn is followed by a greyish white somewhat plumbeous ocellus containing a few black scales. The costal area from the basal patch outward consists of numerous, short, dark brown streaks interspaced with greyish white ones and bordered below at the apex with an irregular patch of golden brown scales. Fringes and hind wing as the male. Expanse 15 mm.

Holotype—♂, Bell's Corners, Ont. Bred from wild apple and emerged in incubator Feb. 7, 1942 (J. McDunnough); No. 5384 in the Canadian National Collection, Ottawa. Fig. 9.

Allotype—♀, same data as holotype. Feb. 16, 1942. Fig. 10.

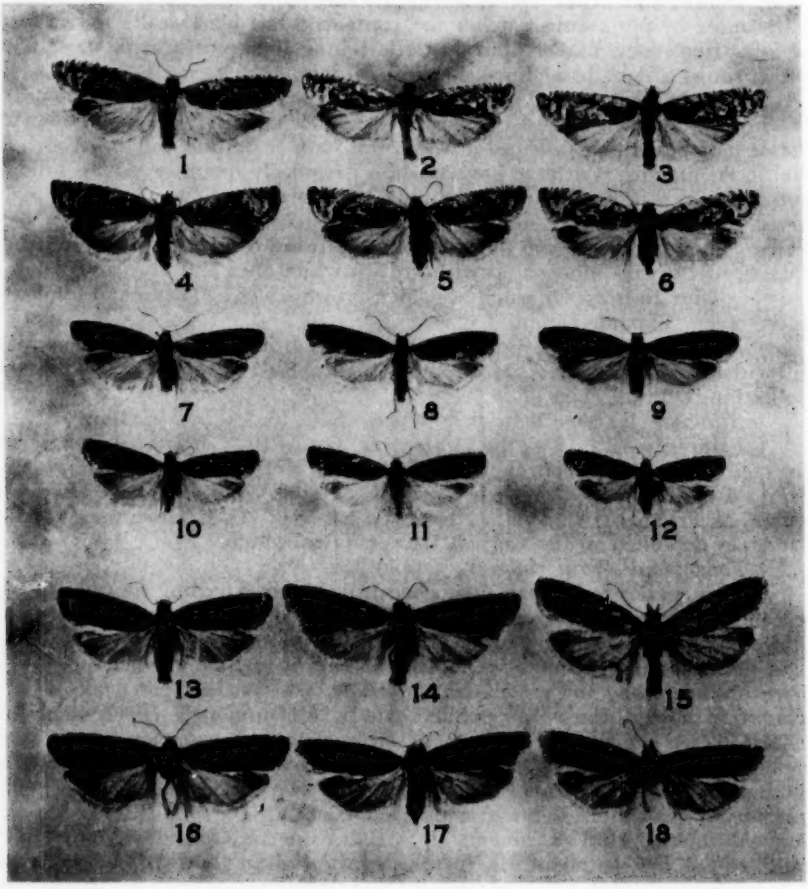
Paratypes—12 ♂, 8 ♀, Bell's Corners, Ont. Bred from wild apple and emerged in incubator Feb. and Mar., 1942 (J. McDunnough and T. N. Freeman); 6 ♂, 22 ♀, Bell's Corners, Ont., Apr. 18, 20, 30, 1941 (J. McDunnough and T. N. Freeman); 1 ♂, Hall, N. Y., Apr. 21, 1942 (D. E. Greenwood). Three paratypes deposited in the Cornell University collection.

Food plant—Pyrus malus L. (apple).

This species is easily distinguished from the oak feeding *improbana* Wlk. and the poplar feeder *oregonana* Wlk. by its much smaller size and by the golden brown color of the male forewing. The females are much more strongly marked than the males and resemble the females of *improbana,* but the geminations are more obscure along the costa, and the white, post median patch of the hind margin is more distinct. As pointed out by McDunnough (1940, Can. Ent., LXXII, 244.) the female genitalia of *improbana* and *oregonana* are distinct enough to warrant specific separation, but the female genitalia of *mali* resemble those of *improbana* so closely that in the latter two species these genital organs can not be used safely as a means of specific separation. All three species, i.e. *improbana, mali,* and *oregonana,* fly together in the Ottawa region, but the adults can all be separated easily by the characters given above and by the accompanying figures. Figs. 1-6 show the large *improbana* which possesses strong costal geminations and which we have reared from oak. Figs. 7-12 illustrate the apple feeding *mali* which, in the females (figs. 10-12), shows the basal costal area darker than that of the females of *improbana. Oregonana,* figs. 13-18, is a large evenly suffused species, showing a tendency for the usual *Pseudexentera* pattern in some of the females (fig. 16) but never as strongly marked as *improbana.* We have reared *oregonana* from poplar and it appears to be confined to this plant. The moths of these three species fly in the early spring just before the leaf buds have opened, at which time the females oviposit on the terminal twigs. The eggs of all three species are quite similar; flat, deep purple-brown with pale mauve perimeters and with two similarly colored irregular streaks in the centre or pale mauve with a submarginal dark purple ring bisected longitudinally by a dark streak.

The larva of *mali* has an intensely black head and prothoracic plate during

the early instars, but later the head becomes light brown with darker sides and the plate almost entirely pale or tinged with brown laterally. The body otherwise is dull yellowish white and becomes greenish just before aestivation. This larva appears to reach maturity very quickly.



SPECIES OF *PSEUDEXENTERA* HEINR.

1-3, ♂, *P. improbana* Wlk., Aylmer, Que.; 4, ♀, *P. improbana* Wlk., Merivale, Ont.; 5-6, ♀, *P. improbana*, Wlk., Aylmer, Que.; 7-8, ♂ paratypes, 9, ♂ holotype, 10, ♀, allotype, 11-12, ♀ paratypes, *P. mali* n. sp., Bell's Corners, Ont.; 13-14, ♂, *P. oregonana* Wlshm., Merivale, Ont.; 15, ♂, *P. oregonana* Wlshm., Edmonton, Alta.; 16-18, ♀, *P. oregonana* Wlshm., Jock River, (Merivale), Ont.

The larva of *improbana* resembles that of *mali* in the early stages. In the final stage the head is shiny black; prothoracic plate mostly pale with variable blackish lateral and posterior suffusion; body pale yellowish-white becoming dirty white just before aestivation.

The larva of *oregonana* is very similar to that of *improbana*. In the last instar the head is scarcely as black and is tinged with brownish, especially in the

central area; prothoracic plate dirty white, with a marginal brownish band which is broader laterally. Body whitish.

The larvae of these three species become full grown in about two weeks and enter the soil where they spin small, oval, dark brown cocoons and aestivate as mature larvae. Pupation takes place in early fall and, as previous mentioned, the adults emerge very early the following spring.

BOOK NOTICE

ATLAS OF THE SCALE INSECTS OF NORTH AMERICA, SERIES IV

By Gordon Floyd Ferris. Published May 28, 1942, by Stanford University Press, Stanford University, California. Price unbound $5.75, bound $6.75.

The issuing of Series IV of Ferris's *Atlas of the Scale Insects* marks the completion of his studies on the family Diaspididae, the largest, from the standpoint of number of species, of any of the families of the Coccoidea. Less fortunately it marks the indefinite suspension of the entire *Atlas,* as originally conceived to include all the known North American Coccoidea, unless a source of funds is found to eliminate the financial loss which is certain to accompany the issuing of further series under present world economic conditions. This situation is rendered all the more tragic since the author states he "stands ready to do the work that will be involved in carrying the original project through the six to ten years more that will be necessary for its completion", provided some way is found to pay for it.

In view of these conditions it is therefore exceedingly gratifying that Series IV has been issued since it marks a natural stopping point in the series, which thus far consists of a complete and self-contained account of the family Diaspididae.

Series IV is of the same general pattern as the three previous series (Notices: Can. Ent., LXXI, 79, 1939; LXXIII, 236, 1941) and treats with a total of 52 species, 21 of which are described as new, distributed among the tribes Diaspidini and Aspidiotini of the subfamily Diaspidinae, and the subfamily Phoenicococcinae. In addition the present series contains an extensive section consisting of discussions on the classification and definition of higher categories, the family, subfamilies and tribes; a detailed morphological account of the family; and keys for the identification of all the species and higher groups contained in the first four series. The series concludes with an epilogue and a general index.

It may be timely to point out here a few features for which the *Atlas* is noteworthy. The scale insects, which the author prefers to regard as constituting a superfamily, the Coccoidea, have been, and to a large measure still remain, one of the least perfectly known groups of Insecta. The 345 species of Diaspididae treated by Ferris constitute, in his opinion, probably not more than one-third of the species of this family that actually exist within the area involved. Further the Diaspididae probably constitute upwards of one-third the total number of species in the superfamily Coccoidea. Thus the *Atlas* to date contains only a small fraction of the estimated total number of North American species of Coccoidea. On the other hand the present treatise is remarkably complete in that of the 350 known species all but five are accounted for among the species discussed and illustrated or among their synonyms.

As announced by the author in his introduction to Series I the primary intention of the *Atlas* is to make possible the identification of species, by means of plates of illustrations, with a minimum of textual material. Consequently he has confined his remarks on problems of classification to the essentials required for the explanation of the system he employs. Nevertheless the rapid expansion of knowledge of the Diaspididae has necessitated the development of

a system of classification for that group which contains many innovations in regard to the composition of genera and higher categories. Finality is not claimed for the system adopted. Rather it is regarded by the author as a reasonably sound basis foreshadowing that arrangement which will ultimately develop. The author emphasizes the sharp distinction existing between problems of classification and problems of identification of species. His views on these matters and his instructions regarding the construction and use of keys are expressed with great clarity.

Ferris has long been known as the exponent of a distinctive and highly refined methodology as applied to systematics. In his now well known manual, *The Principles of Systematic Entomology,* he has proposed and elaborated the techniques and principles he believes essential to sound systematics. In the present *Atlas* he appears to have to have applied, as fully as data and materials permit, the criteria he has laid down. It will be a great pity if the series now lapses solely for want of financial support.

G. S. Walley

THE AMERICAN COMMISSION ON SCIENTIFIC NOMENCLATURE IN ENTOMOLOGY

The disturbed condition of the world during the last few years has interfered with the activities of the International Commission on Zoological Nomenclature and there is no prospect that this Commission will again function successfully for several years to come. Entomologists in the United States have felt that this situation should not be allowed entirely to stifle progress in the development of nomenclature and the clarification of nomenclatorial problems. At the meetings of the Entomological Society of America and the American Association of Economic Entomologists in San Francisco, in December, 1941, a plan was adopted which called for the establishment of an American Commission on Scientific Nomenclature in Entomology.

In accord with the terms of this plan, Mr. C. F. W. Muesebeck and Professor G. F. Ferris were appointed to organize the Commission. That organization has now been completed and the Commission is ready to function. It includes Prof. J. C. Bradley, of Cornell University; Mr. W. J. Brown and Mr. G. Stuart Walley, of the Division of Entomology of the Department of Agriculture of Canada; Prof. G. F. Ferris, of Stanford University; Prof. T. H. Hubbell, of the University of Florida; Prof. H. B. Hungerford, of the University of Kansas; Dr. E. G. Linsley, of the University of California; Prof. Clarence E. Mickel, of the University of Minnesota; Mr. C. F. W. Muesebeck and Mr. P. W. Oman, of the United States Bureau of Entomology and Plant Quarantine; Prof. A. G. Richards, Jr., of the University of Pennsylvania; Dr. Herbert H. Ross, of the State Natural History Survey of Illinois; Prof. C. W. Sabrosky, of the State Agricultural College of Michigan; Dr. R. L. Usinger, of the College of Agriculture of California. Prof. G. F. Ferris has been elected as Chairman.

The Commission will receive, consider and advise upon such nomenclatorial problems as are presented to it. All acts of the Commission will be in harmony with the International Rules of Zoological Nomenclature, although recommendations for the clarification, extension and improvement of these rules may be made. The Commission will report to the two parent societies at their next annual meeting. Communications concerning matters within the province of the Commission may be addressed to any of its members.

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